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CLINICAN RECASTS AND PRODUCTION OF COMPLEX SYNTAX BY  
CHILDREN WITH AND WITHOUT SPECIFIC LANGUAGE IMPAIRMENT

by

Rebekah Wada

A thesis submitted in partial fulfillment  
of the requirements for the degree

of

MASTER OF SCIENCE

in

Communicative Disorders and Deaf Education  
(Speech-Language Pathology)

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Logan, Utah

2015

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## ABSTRACT

Clinician Recasts and Production of Complex Syntax by  
Children With and Without Specific Language Impairment

by

Rebekah Wada, Master of Science

Utah State University, 2015

Major Professor: Dr. Sandra Gillam

Department: Communicative Disorders and Deaf Education

Studies have indicated that separate use of the technique of priming and recasting can increase the use of complex syntax by children with and without specific language impairment (SLI). The current study was devised to examine whether children with SLI differ from children who are typically developing (TD) in the use of relative clauses in response to an intervention composed of a combination of priming and recasting. Twenty-six children (13 with SLI and 13 TD) ranging in age from 6 years, 10 months to 10 years, 11 months participated in the study. Forty pairs of stimulus pictures and sentences for each relative clause type (SR and OR) were created. The examiner presented the picture and read a sentence to the participant. Next, a new picture was shown and the participant created a sentence. The examiner then recasted the participants' responses into the desired syntactic form. A preliminary ANOVA for the

trials to criteria (3 out of 4 consecutive correct responses) for the subject relative and object relative clauses revealed nonsignificant main effects for Order and Group by Order interactions. A two-way mixed ANOVA was conducted to assess differences between the two groups and the two sentence types when compared with the trials to criteria scores. There was a significant effect for group where the SLI group required more trials to reach the criteria for both sentence types than the TD group. Additionally, the subject relative sentences were easier for the participants in both groups (TD and SLI) than the object relative sentences. A regression analysis conducted to predict the trials to criteria scores for both sentence types using the participants' age, CELF raw score, and UNIT raw score revealed that the CELF raw score was significantly related to the trials to criteria score for the two sentence types. When additional analysis of the group and sentence type interaction was completed with the CELF raw score as a covariate, the group main effect was no longer significant. Analyses of the error patterns observed in the sentences produced by the participants as well as implications of the results are discussed.

## PUBLIC ABSTRACT

Clinician Recasts and Production of Complex Syntax by  
Children With and Without Specific Language Impairment

This study examined whether children with specific language impairment (SLI) respond differently than children who are typically developing in response to an intervention composed of the strategies of priming and recasting. Twenty-six children between the ages of 6 years, 10 months to 10 years, 11 months participated in the study (13 with SLI and 13 developing typically). The intervention was completed in one session. Findings revealed that both children with and without SLI were able to be primed to produce subject relative and object relative sentences with subject relative clauses being easier to produce than object relative clauses.

Rebekah Wada

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## INTRODUCTION

Recent studies have attempted to identify specific factors that may cause children with Specific Language Impairment to have difficulty with language. For example, Hestvik, Schwartz, and Tornyova (2010) examined whether children with SLI have impaired knowledge of grammatical structures or if their problems with language are due to difficulty in processing. In their study, children with typically developing language (TD) and children with specific language impairment (SLI) listened to sentences containing relative clauses. Then, they were asked to name pictures that illustrated the relativized noun or a control word in either the pre-gap control position or the gap position. The relativized noun was an animal that was the subject of a relative clause. For example, in the sentence, “The zebra that the hippo on the hill had kissed on the nose ran far away,” the relativized noun was “zebra.” Pictures presented in the pre-gap position were shown before the verb while the gap position occurred after the verb. For example, the pre-gap position in the previous example sentence was after “on the hill.” The gap position occurred after “had kissed.” After each sentence was presented, the participants were asked to answer a comprehension question. The questions could be about either the main subject, the subject of the relative clause, or the object of the relative clause (e.g. who had kissed the zebra? or who had the hippo kissed?) Hestvik et al. found that the children with SLI were less accurate and responded more slowly than the children that were developing typically at naming the picture. However, both groups demonstrated similar accuracy in answering the comprehension questions. Because the children with SLI were able to answer the comprehension questions but not name the

pictures, the researchers proposed that their difficulties with language were due to language processing and not lexical knowledge.

Since children with SLI have been shown to have difficulties with language processing, they may benefit from the use of strategies that highlight specific parts of sentences. One strategy that has been studied is the use of syntactic priming. Syntactic priming refers to the predisposition of a participant to repeat sentences using syntactic structures that have been recently encountered after hearing them spoken (Bock, 1986). For example, a child that has been exposed to sentences following a subject-verb-prepositional phrase form, the more likely the child is to produce sentences that contain a subject-verb-prepositional phrase instead of a different sentence form. Studies of syntactic priming with young children have been conducted to explore whether children use syntactic forms separately from lexical items (or lexical priming). Lexical priming is the use of a specific learned word pattern instead of a general grammatical rule when forming sentences. Huttenlocher, Vasilyeva, and Shimpi (2004) showed that the priming effect was due to syntactic priming rather than lexical priming. In experiment 1, the experimenter showed the child a picture and described it. The child then repeated the experimenter's sentence. Another picture was presented and the child created an original sentence to describe the picture. Each child received 10 trials with transitive sentences (including either active or passive primes) and 10 trials of dative sentences (including either double-object or prepositional phrases). An active transitive sentence was "*the river flooded the town*" while a passive transitive sentence was "*the town was flooded by the river.*" A preposition dative sentence was "*the boy is feeding a bone to the dog*" while a double-object dative sentence was "*the boy is feeding the dog a bone.*" The

sentences were created so that each picture set did not include the same words for the object and the action. This is because the researchers were examining the priming of the sentence structure and not of the words used. The researchers found that the children were able to use the primed sentence structure even when the lexical features of the sentence differed. The children were able to use dative and transitive sentences even when the objects and actions of the primed sentences and pictures differed from the participant's pictures. If the children were using lexical priming instead of syntactic priming to form the sentences, they would create dative and transitive sentences with only a select few words, specifically when the objects/actions in the priming sentences were the same as those in the participant's pictures.

In experiment 2, Huttenlocher et al. repeated the same process except that children did not have to repeat the experimenter's sentences. The researcher's found that the children produced the primed sentences similarly to those produced in experiment 1 without needing to repeat the sentences. The findings from this study suggest that repetition of the priming sentence is not necessary in order for the child to learn the syntactic structure.

Finally, in experiment 3 of their study, Huttenlocher et al. conducted tests to see whether the effect of syntactic priming would persist past one trial. In their study, the examiner described ten different pictures in a row and then the child described ten pictures in a row. They found that the participants' use of the targeted structures increased during the experiment even with ten trials between the priming sentences. This finding suggests that syntactic priming employs the use of implicit learning because the structures were used accurately without being explicitly taught. Further research is

necessary to determine whether the effects of the priming represent long-term changes in the syntactic system.

To date, most studies of syntactic priming have been conducted to investigate primacy effects in typically developing children for theoretical purposes. It's not known whether children with SLI would benefit from priming to the same extent as children developing typically. Garraffa, Coco, and Branigan (2012) examined the effect of syntactic priming for subject relative sentences with 19 children developing typically and 19 children with SLI. The mean age for all the children was 5 years, 4 months. A sentence repetition task and a priming (picture description) task were administered. For the sentence repetition task, the examiner said a sentence to the child and the child repeated the sentence back to the examiner. During the priming task, the examiner described a picture with a subject relative clause and then asked the child to describe a different picture. The children in the TD group produced more subject relative clauses than the children with SLI during the priming task. The researchers found that both groups (TD and SLI) were more likely to produce a subject relative clause after hearing a subject relative clause. However, a cumulative priming effect only occurred for the children that were developing typically. Cumulative priming means that the more frequently the typically developing child used a subject relative clause, the more likely they were to use a subject relative clause again.

The children with SLI had a more difficult time with the subject relative clauses in the repetition sentences than in the priming task. The researchers proposed that children with SLI may have had an abstract representation of subject relative clauses, which they were able to use when provided with an example (from priming). This would

explain why the children with SLI used more subject relative clauses during the priming task than during the repetition task. As reported by these studies, the technique of priming can be an effective way to increase the use of relative clauses by children who are typically developing as well as children with SLI.

Related to syntactic priming is a technique called “recasting,” which is when a conversational partner restructures a child’s utterance in a way that increases its grammatical accuracy or modifies the sentence structure while still incorporating the child’s intended meaning (Nelson, Camarata, Welsh, Butkovsky, & Camarata, 1996). Speech language pathologists have long employed the use of recasts to facilitate the use of various syntactic forms for young children with language impairment. For example, in an early study, Nelson et al. (1996) examined the use of recasting in conversational settings with children developing typically from the ages of 2 to 4 and with children with SLI aged 4 to 6. Both the children developing typically and the children with SLI had comparable language skills. Nelson used two different methods to elicit the selected targets: imitated speech and conversational recasts. The targets that were selected for the children were from Brown’s stages III-V+ and included gerunds, auxiliaries or copulas, past tense, articles, third person singular, possessives, relative clauses, passives, complex negatives, complex questions, wh-complement, simple infinitives, complex infinitives, and coordinate conjunctions. Each child had six different targets, three that were absent and three that were emerging (<30% correct usage as seen in the language samples) in their language repertoires. The targets were randomly assigned to be addressed in a control condition, an imitative treatment, or a conversational recast treatment. In order to compare the children with SLI to the children that were developing typically, the



researchers matched each child with SLI to a child developing typically who had similar language targets. During the imitation treatment, children were asked to imitate the clinician's model during structured play tasks. In the conversational treatment, the clinician recasted what the children said in a free play task. The researchers found that the children (both SLI and typically developing) produced the target faster within the conversational recast condition than the imitated treatment context, supporting findings observed by Garraffa et al. (2013). Garraffa et al. found that children with and without SLI produced more subject relative clauses during a priming task that required the child to produce original sentences than during a sentence repetition task. Nelson et al. (1996) showed that both the participants with SLI and the children that were developing typically were able to learn the targeted skills within the conversational recast condition and were able to generalize the skills to spontaneous speech.

Recasting of specific syntactic targets has also been studied. Proctor-Williams and Fey (2007) examined children's ability to learn and use novel irregular past tense verbs after receiving conversational recasts. The study compared the performance of 13 children with typically developing language between the ages of 5 and 6 to 13 children with SLI between the ages of 7 and 8. The researchers created six novel present tense/past tense verb pairs (dake/doke, jare/jore, twink/twank, plo/plew, ling/lang, kig/kug) and trained the participants on the meaning of the verbs. Each child received three verbs with the low-density recast context (0.2 per minute) and three verbs with the high-density recasts context (0.5 per minute). The recasts were conducted over five treatment sessions and the order that the children received the low-density and high-density recasts were switched with each training session. During the treatment sessions,

each child had at least five opportunities to correctly produce each past tense verb. Each production was marked as correct or incorrect. Incorrect responses were followed by a recast from the researcher. Proctor-Williams and Fey (2007) found that the children with typically developing language produced more irregular past tense verbs correctly with the low-density recasts than with the high-density recasts. The production rates of the children with SLI did not change as a function of low-density or high-density recasts (Proctor-Williams & Fey, 2007).

Previous studies have shown that children with SLI are able to benefit from the use of recasts. Because the children with SLI were not able to correctly use the past tense verbs even with the recasts from the researchers, it is possible that Proctor-Williams and Fey may not have given children enough opportunities to produce the target structures.

Parental use of recasts in conversational speech was studied by Proctor-Williams, Fey, and Loeb (2001). Ten children with SLI and ten children with TD language were recruited for the study. The children had MLUs ranging from 1.5 and 2.5. The participants with SLI were an average age of 41 months (33-50 months) while the children with TD language were an average age of 24 months (21-26 months). The interactions between the children and their parents were recorded during a 30-minute play activity. The researchers examined the interactions for parental recasts of: the uncontracted copula forms of “am,” “is,” “are,” “was,” “were;” the contracted forms of “\_’m”, “\_’s”, and “\_’re;” and the article forms of “a,” “an,” and “the.” For the children with TD language, parental recasts were found to result in an increased use of copulas. The children with SLI did also made improvements in their use of copulas, but there was

no correlation between the parents' use of recasts and their increased use of copulas (rate:  $r = -0.31$ ,  $p = 0.001$ ; context:  $r = -0.44$ ,  $p = 0.001$ ). While the parental recasts were beneficial for the children that were developing typically, they did not influence the gains made by the children with SLI.

While the majority of child language research has focused on young children's use of simple syntax, some researchers have examined school age children's ability to imitate and produce relative clauses in sentences. Frizelle and Fletcher (2014) conducted a study in Ireland that compared children with SLI with children developing typically on their ability to produce relative clauses. The children were divided into three groups: 32 children with SLI (mean age of 6;11), 32 age-matched children who were developing typically (mean age of 6;10), and 20 younger children who were also developing typically (mean age of 4;9). The children were asked to repeat presentational and dual propositional sentences. Each condition (presentational vs. dual propositional) contained eight different types including subject intransitive (Si), Subject transitive (St), Indirect object (Io), and Oblique (Obl). A presentational subject intransitive sentence presented was, "This is the bird that slept in the box all night." A dual propositional intransitive sentence was, "*The girl cleaned up the milk that spilt in the fridge.*" A presentational transitive sentence was, "*There is the sheep that drank the water this morning.*" One of the dual propositional transitive sentences was, "*Eddie met the girl who broke the window last week.*" An indirect object presentational sentence was, "*There is the dog that the man kicked his football to.*" An indirect object dual propositional sentence was, "*Anne fed the baby who Emma sang a song to.*" An example of an oblique presentational sentence was, "*There is the tree that the car crashed into last night.*" A dual

propositional oblique sentence was, “*Anne painted the picture that the girl looked at today.*” The researchers created a total of 52 relative clause sentences and 17 filler sentences. The researcher would tell the sentence to the child who repeated the sentence out loud. The participant’s responses were scored on a scale from ten (completely correct) to zero. Frizelle and Fletcher found that the children with SLI scored significantly lower than the two control groups on both sentence types. All three groups were more successful with the presentational than the dual propositional sentences. Additionally, the children with SLI were able to produce subject relative sentences more accurately than the object relative sentences. The researchers found that the children with SLI followed the same patterns as the children developing typically but at a significantly lower accuracy level.

In a similar study of children who spoke Hebrew, Novogrodsky and Friedmann (2006) examined school age children’s ability to produce relative clauses in sentences. They compared 28 typically developing children to 18 children with syntactic SLI (S-SLI). Syntactic SLI was described as Specific Language Impairment that included a syntactic deficit in comprehension. The examiner described a picture with two subjects and then the children were asked to describe the picture. As seen with Frizelle and Fletcher, the children with SLI had a more difficult time producing relative clauses (with object relative being harder than subject relative) than the TD children. Analysis of the errors made by the children with S-SLI showed that they would avoid the use of relative clauses by creating simple sentences or they made semantic errors related to the incorrect assignment of the thematic roles. The researchers found that the children with SLI made

no syntactic errors, which proved that the children had the structural knowledge necessary for using relative clauses.

Previous studies have indicated that the use of priming can increase the use of specific syntactic structures in the spontaneous language of children with SLI. While the use of recasting can increase the use of complex syntax by children who are developing typically, this research suggests it does not reliably help children with SLI in the same way. While children with SLI have been shown to be able to use more complex syntax, it is unclear how much of the improvement is due to the use of recasting. It is possible that children with SLI require both priming and recasting to experience the same benefits as children developing typically. A therapy approach that combines these procedures may better impact the syntactic outcomes of children with SLI.

With that in mind, this study was designed to answer the following research questions:

1. Do children with SLI differ from children developing typically on their use of relative clauses in response to priming combined with recasting
2. Do children both developing typically and children with SLI respond differentially to priming combined with recasting for subject relative clauses versus object relative clauses

## METHODOLOGY

### Participants

A total of 31 monolingual English-speaking children ranging in age from 5 years, 5 months to 10 years, 11 months were recruited from local schools for participation in this study. One participant was disqualified from the study due to using a cochlear implant. Four other participants were not included due to being far younger in age than the other participants. A total of 26 children ranging in age from 6 years, 10 months to 10 years, 11 months were used for this study. Thirteen of the children were diagnosed as having a language impairment and earned composite standard scores at or below 81 on the *Clinical Evaluation of Language Fundamentals, 4th Edition* (CELF-4; Semel, Wiig, & Secord, 2003). The children in the SLI group were already identified as SLI and had previously received the complete CELF-4. Children were included in the study if they earned standard scores of 4 or greater on the Symbolic Memory subtest of the Universal Nonverbal Intelligence Test (UNIT; Bracken & McCallum, 1998). The participants could not present with a hearing impairment, a visual impairment, gross neurological impairment, oral-structural anomalies, or emotional/social disorders. Children were excluded if parents reported a history of focal brain lesions, traumatic brain injury, cerebral palsy, seizure disorders, symptoms of severely impaired reciprocal social interaction, or severely restricted activities listed in the DSM-V criteria for autism spectrum disorders. A summary of the participants' ages, CELF raw scores, CELF standard scores, Unit raw scores, and Unit standard scores is provided in Table A.1. The

Sentence Repetition subtest of the CELF-4 was administered to all of the children whose parents reported them to be typically developing to screen for potential language impairments. All of the children that were developing typically earned standard scores of 7 or higher on the sentence repetition subtest with the exception of Participant 004 (standard score of 6). The children with SLI earned standard scores on the CELF-4 Recalling Sentences subtest that ranged from 1-9 with an average score of 4.

## **Materials**

### **Experimental Stimuli**

Forty pairs of stimulus pictures and sentences for each sentence type (subject relative and object relative) were created for use in the experiment. Each stimulus pair included one picture for the examiner to describe using a subject relative or object relative sentence and one picture for the child to describe using the same syntactic form. The pictures contained people, animals, and/or objects performing actions. All stimuli were presented orally by the examiner in the past tense and contained a prepositional phrase. Each picture was printed in color on cardstock cards approximately 4x6 inches in size. See Appendix B for a list of all the sentences used during the picture description task. The same relative marker (“that”) was used in all the created sentences.

## **Procedures**

Two examiners trained in the priming and recasting procedures administered the assessments and experimental tasks to the children in the study. The order of the presentation of the sentence types was counterbalanced across participants. Therefore, twelve of the children received the subject relative sentences followed by the object relative sentences and fourteen received the object relative sentences followed by the subject relative sentences. Originally each group contained fifteen participants, but due to the four participants that were not included due to their young age, the number of participants in each group dropped to fourteen and twelve. The order of the sentence types was randomized and pre-assigned to participant ID numbers (see Appendix C for the order assigned to each participant ID number). The participant ID numbers were distributed sequentially to the children as they came in for the eligibility testing session. Both sentence types were targeted in the same session. For example, during the first half of the session, Participant 001 was asked to describe pictures containing object relative sentence forms such as “*The flower that the lady planted in the dirt was yellow*” after an object relative sentence prime. During the second half of the session, Participant 001 was asked to describe novel pictures containing subject relative sentence forms such as “*The man that held the fork in his hand was sad*” after a subject relative sentence prime.

At the beginning of the instructional session, the examiner administered the first 20 paired-stimuli of one sentence type (e.g., subject relative) followed by the second 20 paired-stimuli of the other sentence type (e.g., object relative). The children were instructed to look at the picture and listen to the examiner’s sentence. The children were told that they would make their own sentence describing a new picture and were asked to try and make their sentence sound like the examiner’s. After each of the child’s



sentences, the examiner either recasted the sentence into the correct form if it was incorrect or simply repeated the syntactically correct sentence produced by the child. The examiner would continue to use the same relative marker (“that”) in each of the recasts. This procedure was continued until all of the stimuli were presented. For example, Participant 002 was shown a picture of a car that had crashed into a tree. The examiner said, “*The car that hit the tree next to the street was blue.*” Then, the examiner showed Participant 002 a picture of a boy hitting a golf ball with a golf club. The child described the picture by saying, “*A boy hit a golf ball very high.*” Because the child did not use the desired sentence structure (“the boy that hit the ball into the air was happy”), the examiner recasted the child’s sentence saying, “*The boy that hit the golf ball into the air was happy.*” “Ball” in the desired sentence was changed to “golf ball” in order to more closely mimic Participant 002’s sentence. This procedure was continued until 20 paired stimuli were presented for that sentence type. An intervening activity was then introduced in which the children played an iPad game called Fruit Ninja Free (Halfbrick Studios, 2013) for three minutes. Following the intervening activity, the participants were presented with 20 new, paired stimuli containing the remaining sentences in that set.

Once all 40 paired stimuli of one sentence type were completed, the examiner administered the Sentence Repetition subtest of the CELF-4 and the Symbolic Memory subtest of the UNIT. The CELF-4 and the Symbolic Memory subtest of the UNIT were administered in the middle of the testing session so as to provide a verbal task to break up the two picture description tasks. After completing the two standardized subtests, the examiner presented the stimuli for the second sentence type. For example, Participant 001 completed the object relative stimuli during the first half of the session, so after the

two standardized subtests were administered the examiner presented the subject relative stimuli. The same structure that was used during the first half of the session with the first sentence type (subject relative or object relative) was followed during the second half with the remaining sentence type (i.e. twenty picture pairs then a three-minute activity then twenty picture pairs). All testing was completed in one session that ranged from 60 to 75 minutes in length. Refer to Appendix D for the standardized instructions used by the examiners during each testing session.

### **Fidelity**

A research assistant was trained in the priming and recasting procedure. She received explanations of what the priming and recasting procedures were as well as examples of recasted sentences. She also received multiple opportunities to practice providing recasts with feedback provided by the first author. Prior to conducting her first session, the research assistant was observed during a mock session by the first author. Three of research assistant's testing sessions were analyzed in order to determine the number of primes and recasts administered correctly. The reliability of the primes and recasts was judged at 97%.

### **Scoring**

The participants responses were scored based on use of the desired sentence structure. A sentence was judged to be correct if it followed the primed sentence

structure. The sentences were not judged on verb tense agreement. For example, if the child said, “The boy that holds the ball looked mad,” the sentence would be marked as correct even though the sentence contained different verb tenses. If the child used “who” instead of “that,” the sentence was marked as correct and noted as having a relative marker change (RMC). For example, the sentence, “*The boy that hit the ball into the air was happy*” would change to, “*The boy **who** hit the ball into the air was happy.*”

### **Reliability**

All sessions were recorded using an audio recorder and a video recorder. The sessions were transcribed from the audio recordings by two members of the research team using *Systematic Analysis of Language Transcripts (SALT)* software (Miller & Iglesias, 2008). In order to calculate word-by-word reliability for transcriptions, one researcher re-transcribed three of the six participant sessions that were transcribed by the research assistant. Word-by-word reliability was 97%. Any discrepancies were discussed and resolved by the first author.

A research assistant scored all the transcripts that contained the examiner’s primed sentence, the child’s response, and the examiner’s recast to determine the number of correct sentences produced by the participant and to calculate the number of trials that were needed for the child to reach a pre-determined criteria for mastery (three out of four consecutive sentences produced correctly). A second examiner also scored all of the transcripts. To establish intra-rater reliability, the same researcher (first author) rescored all of the de-identified transcriptions. Intrarater reliability was found to be at 99%.

Inter-rater reliability was calculated by a third researcher. He was trained how to score the participant's responses by the first author. The responses from three participants from the TD group and three from the SLI group were analyzed. Inter-rater reliability was found to be at 95.8%. Any discrepancies were resolved by the first author.

### **Data Analysis**

Recall that in order to control for potential order effects, children were randomly assigned to one of two presentation orders (subject relative first or object relative first). Preliminary ANOVA for Subject Relative Trials to Criteria (SRTTC) and Object Relative Trials to Criteria (ORTTC) revealed non-significant main effects for Order and Group x Order interactions. Therefore, order was not entered into subsequent statistical analyses. Two-way mixed ANOVA were conducted to evaluate the statistical reliability of the group differences on learning to produce relative clauses from clinician models paired with growth-relevant recasts. The dependent variable was trials to criteria. The between-subjects variable was Group (SLI, TD) and the within-subjects variable was Sentence Type (subject relative, object relative). Two multiple regression analyses were conducted to predict the trials to criteria for subject relatives and object relatives from the predictor variables of age (in months), the CELF raw score, and the UNIT raw score. In both regressions, the CELF recalling sentences raw score was the only variable that entered into the equation using  $p < .05$  as the probability to enter.

## RESULTS

Table E.1 presents the average number of trials required for subjects in the SLI and TD groups to reach criteria on the subject relative clause and object relative clause tasks.

There were significant main effects for Group,  $F(1,24) = 7.25, p = .013, \eta^2 = .232$ , and Sentence Type,  $F(1,24) = 23.79, p < .001, \eta^2 = .498$ . Across sentences, the children in the SLI group required more trials to reach criteria ( $M = 26.04, SD = 13.56$ ) than the children in the TD group ( $M = 14.73, SD = 12.27$ ). Across the two groups, participants took fewer trials to reach criteria for the subject relative sentences ( $M = 13.14, SD = 12.79$ ) than the object relative sentences ( $M = 27.62, SD = 15.32$ ). The Group x Sentence Type interaction was not significant. In summary, the children in the SLI group required more trials to reach criterion on both sentence types. For both groups (TD and SLI), the object relative clause sentences were harder (required more trials to reach criteria) than the subject relative clause sentences.

A scatterplot depicting the relationship between the CELF recalling sentences raw scores and the subject relative trials to criteria scores for the TD and SLI groups are presented in Table E.2. Table E.3. includes a scatterplot depicting the relationship between the CELF recalling sentences raw scores and the object relative trials to criteria scores for the TD and SLI groups. The regression for the subject relative sentences was significant,  $R^2 = .344$ , adjusted  $R^2 = .317, F(1,24) = 12.582, p = .002$ , as was the regression for the object relative sentences,  $R^2 = .515$ , adjusted  $R^2 = .495, F(1,24) = 25.473, p = .0001$ . A measure of general syntactic knowledge (the CELF recalling

sentences raw score) was strongly related to the trials to criterion indices for both subject relative and object relative clauses. Age and nonverbal IQ (as measured by the UNIT Symbolic Memory subtest) offered little additional predictive power. Additional support for this conclusion is the strength of the bivariate correlation between the CELF recalling sentences raw score and the dependent variables (-.586 for SRTTC and -.718 for ORTTC).

Based on these results, the Group x Sentence Type effect was re-analyzed using the CELF recalling sentences raw score as a covariate. Preliminary analyses were conducted to evaluate the homogeneity-of-slopes assumption for SRTTC and ORTTC separately. The relationship between the covariate and the dependent variable did not differ significantly as a function of Group for either sentence type. Therefore, mixed ANCOVAs were conducted. The covariate was significant,  $F(1,23) = 20.90, p = .0001, \eta^2 = .477$ . As with the earlier mixed ANOVA, the main effect for Sentence Type was significant,  $F(1,23) = 5.52, p = .028, \eta^2 = .194$ , but the Group by Sentence Type interaction was not. However, when using the CELF recalling sentences subtest as a covariate, the Group main effect was no longer significant,  $F(1,23) = .095, p = .761, \eta^2 = .004$ . These results were taken as evidence to suggest that prior language knowledge influenced how children's responded to clinician models (primes) and growth relevant recasts whether they were in the SLI group or the TD group.

The sentences produced by the participants were analyzed for patterns. Tables F.1 and F.2 show the total number of responses made in subject relative sentences in every category for each participant in the TD group and the SLI group. Appendix F contains

definitions and examples for each response category. The responses made were analyzed in groups based on related patterns. Table F.6 details the percentage of total responses that each response group produced for the SR sentence type. Three categories of errors were identified. The first category contained errors that caused the sentence to become ungrammatical. This included the error codes of simple ungrammatical, complex ungrammatical, SR/OR, OR/SR, deletion of “that,” and reduction. Participants in the TD group produced 45 sentences that were ungrammatical (14.52% of total errors made). Participants in the SLI group produced more ungrammatical sentences with 68 total but they only accounted for 17.48% of the total errors made. The percentages of occurrence for each response code in the ungrammatical category are shown in Table F.5.

Participants in the SLI group produced over twice as many simple ungrammatical sentences than participants in the TD group. A simple ungrammatical sentence was a sentence that was ungrammatical that did not include the word “that” or “who.” For example, participant 002 said, “*The cookies in the cookie jar didn’t have a lid on it.*” The target sentence was, “*The cookie that had chocolate chips in the dough was in the jar.*” A complex ungrammatical sentence was a sentence that showed that the participant attempted to include a relative clause by using the word “that” or “who.” For example, participant 014 said, “*The boy that is smiling with his fluffy bunny.*” The target sentence was, “*The boy that held the bunny in his arms was laughing.*”

The SLI group produced more sentences where the first half of the sentence followed the subject relative pattern and the second half followed the object relative sentence pattern (response code SR/OR) while the TD group produced more sentences where the first half of the sentence followed the object relative structure and the second

half followed the subject relative structure (response code OR/SR). An SR/OR sentence from Participant 012 was, “*The girl who cooked toast was delicious.*” The target sentence was, “*The woman that toasted sliced bread in the toaster had a black belt.*” In this SR/OR sentence, the first half (“The girl who cooked toast”) followed the subject relative form. The second half (“was delicious”) followed the object relative form because it refers to the toast and not to the girl. Participant 031 produced an OR/SR sentence by saying, “*The door that the man opened was joyful.*” The target sentence was, “*The man that opened the door with a key was happy.*” In this OR/SR sentence, the first half (“the door that the man opened”) followed the object relative form. The second half (“was joyful”) followed the subject relative form because it refers to the man and not to the door.

The TD group produced more sentences that were correct except for the omission of the word “that” (and in some cases “that” and a helping verb) than the SLI group. For example, Participant 007 said, “*The cat drank milk from the bowl was black on the head.*” The target sentence was, “*The cat that drank the milk from a bowl was still thirsty.*” The sentence produced by Participant 007 followed the subject relative form except for the word “that.”

The reduction error type occurred when the participant would change a complete sentence using “that” into two sentences: one incomplete and one complete. For example, Participant 004 said, “*The girl who was swinging on a swing. Her coat was purple.*” The target sentence was, “*The girl that played on the swings had a purple jacket.*”



The second category included sentences that contained a subordinate clause using “when,” “but,” “so,” “while,” and “because.” The TD group produced 12 subordinate sentences (3.87% of total responses) and the SLI group produced 10 subordinate sentences (2.57% of total responses). Participant 014 produced the following subordinate sentence, “*The man was combing his hair while whistling in a yellow shirt.*” The target sentence was, “*The boy that combed his hair with a comb had a yellow sweater on.*”

The children in the SLI group were more likely to avoid the use of a relative clause by using simple sentences. Children in the SLI group produced almost twice as many relative clause omissions than the TD group. The SLI group produced 154 relative clause omissions (39.59% of total responses) compared to 84 produced by the TD group (27.1% of total responses). An example of a simple sentence produced by Participant 009 was, “*The wiener dog was running away from the horse.*” The target sentence was, “*The horse that chased the dog in the field was running.*” Although Participant 009 produced a complete sentence, no attempt was made to include a relative clause. The SLI group also used more multiple sentence responses (two and three sentences) than the TD group. The SLI group had 31 multiple sentence responses (7.97% of total responses) compared to 3 multiple sentences responses (0.97% of total responses) from the TD group. Participant 020 used a multiple sentence response by saying, “*The dog is happy. And the boy is holding the ball.*” The target sentence was, “*The dog that performed a trick for the boy sat on the floor.*” As with the relative clause omission, the participant created complete sentences but avoided the use of a relative clause.

The TD group was more likely to use an object relative clause instead of a subject relative clause. The TD group produced 14 object relative sentences (4.52% of total responses) and the SLI group produced 6 object relative sentences (1.54% of total responses). For example, Participant 015 said, “*The shirt that the man hung up was blue.*” The target sentence was, “*The shirt that was on the hanger was blue.*” The tendency to use an object relative sentence form instead of a subject relative sentence form was not high for both groups.

Some of the participants in both groups would use the conjunction “and” to create longer sentences. Both groups used the coordinated conjunction “and” 5 times (TD: 1.61% of total responses; SLI 1.29% of total responses). Participant 018 used “and” to describe a picture by saying, “*The little boy picked up the garbage can and emptied it.*” The target sentence was, “*The boy that dropped the paper into the trash had a striped shirt.*”

The last category analyzed included the relative marker and/or tense change error codes. A relative marker change was when the participant use “who” in the place of “that” in the relative clause. For example, Participant 004 said, “*The lady who was watching TV had a red dress on.*” The target sentence was, “*The lady that watched the man on the TV had a red dress on.*” The participant was able to use a subject relative clause in a complete sentence but used the word “who” instead of “that.” Tense change was marked when the participant used a present tense verb instead of the primed past tense verb form, a mixture of present or past tense verbs, or an incorrect verb form (e.g. “threwed” instead of “threw”). For example, Participant 026 said, “*The cat that is trying to climb up the tree wanted those birds.*” The target sentence was, “*The cat that climbed*

*a tree in the forest wanted the bird.*” In Participant 026’s sentence, a present tense verb (“is trying”) is used first and then the tense switches to past tense (“wanted”). The sentences with RMC and/or TC responses were marked as correct for calculation of the amount of total correct sentences and trials to criteria score but the errors were noted for analysis. Participants in the TD group produced 107 RMC responses and 40 TC responses (47.42 % of total responses). The SLI group produced 106 RMC responses and 8 TC responses (29.31% of total responses). Almost half of the responses in the sentences created by the TD group were responses that did not affect the accuracy of the sentence.

The same analysis was completed with the object relative sentence responses. Tables F.3. and F.4 detail the total amount of responses made in object relative sentences in every category for each participant in the TD and SLI group. Unlike with the subject relative sentences, the TD and SLI groups had similar amounts of responses in each category. Table F.8 details the percentage of total responses that each group comprised for the OR sentence type. The first category of errors analyzed included the simple ungrammatical, complex ungrammatical, SR/OR, OR/SR, deletion of “that,” and reduction codes. Participants in the TD group produced 80 sentences that were ungrammatical (25.48% of total errors made). Participants in the SLI group produced more many ungrammatical sentences (133 total) but they only accounted for 29.82% of the total responses. As with the subject relative sentences, the SLI group produced a higher number of ungrammatical responses than the TD group but the percentage of total errors was comparable. The percentages of occurrence for each code in the ungrammatical category are shown in Table F.7.

Participants in the SLI group were more likely to produce simple ungrammatical sentences than participants in the TD group. The TD group produced more sentences that were correct except for the omission of the word “that” than the SLI group. The participants in both groups were more likely to use a split sentence type. Unlike with the subject relative sentence type, the participants showed a strong preference to using the SR/OR split type and used the OR/SR type rarely. Because the majority of ungrammatical errors produced by both groups were with the SR/OR error type, the participants were attempting to use an object relative clause but were not able to make a complete grammatical sentence. The occurrence of the error of reduction occurred less with the OR sentences than with the SR sentences (for both groups).

The next category analyzed included sentences that contained a subordinate clause using “when,” “so,” and “because.” The TD group produced 5 subordinate sentences (1.59% of total responses) and the SLI group produced 9 subordinate sentences (2.02% of total responses).

As with the subject relative sentences, children in the SLI group were more likely than the TD group to avoid the use of a relative clause. The SLI group produced 131 sentences with relative clause omissions compared to 84 produced by the TD group. Unlike with the SR sentence type, the percentage of the total errors was comparable: 29.37% of SLI total responses vs. 26.75% of TD total responses. The SLI group also had more multiple sentence responses (two and three sentences) than the TD group: 33 (7.4% of total responses) for SLI group compared to 2 (0.64% of total responses) for TD group.

Both groups used sentences that were in the subject relative form instead of the object relative form. The TD group produced 105 subject relative sentences (33.44% of

total responses) and the SLI group produced 139 subject relative sentences (28.66% of total responses).

Participants in both groups used the conjunction “and” to create longer sentences. The TD group used “and” two times (0.64% of total responses) while the SLI groups used “and” five times (1.12% of total responses).

The last category of errors analyzed was relative marker and tense changes. Unlike with the subject relative sentence task, the RMC and TC error patterns did not make up a majority of the total amount of errors made for the TD group. Participants in the TD group produced 30 TC responses and no RMC responses (9.55% of total responses). The SLI group produced 1 RMC response and 1 TC response (0.45% of total responses).

The TD participants were more likely to use a relative clause (either SR or OR form) and were primed faster than the children with SLI. The OR sentence type was a harder task for both groups (TD and SLI) and the types and amount of responses that occurred between the two groups were similar.

## DISCUSSION

This study was designed to determine if clinician models or “primes” combined with growth relevant recasts improved the use of specific syntactic structures for school-age children with and without SLI. Participants completed tasks in which they were required to produce subject relative and object relative clauses after clinician models (primes). The clinician also recasted utterances produced by children in response to primes whether they were correct or incorrect.

Children were considered to be sufficiently primed to produce the relative clause sentence type if they reached a criteria of three correct productions out of four consecutive sentences attempted. Most of the children in both groups met the criteria for both subject relative sentences and object relative sentences. However, the children in the SLI group required more trials to reach the criteria than the children in the TD group. In order to reach criteria for subject relative sentences, the TD group required an average of 8.5 trials while the SLI group required 17.8 trials. For object relative sentences, the TD group needed an average of 21 trials while the SLI group averaged 34.2 trials. Participants in both groups (SLI and TD) produced more subject relative sentences in the place of object relative sentences during the object relative priming task. This pattern suggested that the subject relative sentence type was easier for the participants to produce than the object relative sentence type.

Our findings are generally consistent with studies by Frizelle and Fletcher (2014) as well as Novogrodsky and Friedmann (2006). In the study by Novogrodsky and Friedmann, the children with SLI were more likely to use simple sentences to avoid the

use of a relative clause. This same pattern was observed in the current study when the participants were primed for the subject relative sentence type. The participants in the SLI group would avoid the use of a relative clause by using simple sentences and occasionally multiple simple sentences (*“The deer ate leaves. He was hungry.”*). The participants in the TD group were also more likely to attempt to use a relative clause than the SLI group, as seen by more occurrences of relative clauses in the sentences produced by the children in the TD group.

In the study by Frizelle and Fletcher, children with SLI followed the same patterns of production and responses as the children that were typically developing but on a lower level. In the current study, analysis of the mean scores for trials to criteria and total number of correct productions when the CELF raw score was used as a covariate revealed that the participant’s language knowledge influenced their sentence productions. Because the group main effect was no longer significant when analyzing with the CELF raw score covariate, it is possible that when the TD group and the SLI group have similar language scores, they are comparable in terms of accuracy of production. These findings are consistent with those by Frizelle and Fletcher. It is also consistent with the belief that children with SLI may lack the language processing skills and not the syntactic skills necessary for production of complex sentences as documented by Hestvik, Schwartz, and Tornyova.

There is preliminary evidence to suggest that children with language impairment benefit from the use of priming and recasting of complex syntax. The use of the strategy of priming with children with SLI has been previously studied. Huttenlocher, Vasilyeva & Shimpi and Garraffa, Coco, and Branigan found that children with and without SLI

produced more sentences with the targeted syntactic structure after being exposed to the structure in either individual sentences of conversational speech.

The effects of recasting for improving syntax for children with SLI have been studied by multiple researchers. While a study by Nelson et al. (1996) showed that children with SLI were able to learn selected grammatical targets through the use of recasting, other researchers (Proctor-Williams & Fey, 2007; Proctor-Williams et al. 2001) found that the use of recasts did not affect the increased use of grammatical targets by the children with SLI.

Because of the contradictory results for the effectiveness of recasts with children with SLI, the current study combined the use of priming and recasting. When both strategies were used, the children with SLI were able to create sentences using subject relative and object relative clauses. While the children with SLI needed more trials than the children who were developing typically in order to reach the criteria for being primed (three out of four correct consecutive sentences), they were able to be primed for both subject relative and object relative clauses. The use of priming followed by recasting appeared to be useful increasing the amount of complex sentences produced by the participants with SLI.

The children with SLI's levels of responsiveness was significantly related to their prior syntactic knowledge rather than their age or nonverbal intelligence. When the CELF Recalling Sentences subtest scores by the participants with and without SLI, was entered into the analysis, the Group main effect was not significant. The participants performed similarly with the subject relative and object relative sentence production when equated for language ability. This finding was also observed in an experiment



performed by Frizelle and Fletcher that compared children with SLI with children that were typically developing. They found that the children with SLI produced responses that were similar to those of children developing typically (both age-matched and a few years younger) but at a lower level. By focusing on increasing exposure to various syntactic forms, a clinician may see improvements in children's use of these forms.

Additionally, when the children with SLI produced incorrect responses they were more likely to be ungrammatical than those produced by children developing typically. The children with SLI created simple sentences with correct grammar or attempted to use the more complex sentence form, which resulted in more ungrammatical sentences.

This tradeoff between form and content has been noted in narratives produced by children with SLI. Colozzo, Gillam, Wood, Schnell, and Johnston (2011) studied narratives created by children with SLI. The children with SLI created narratives that either contained less content but were grammatically correct or elaborate stories with poor grammar. The researchers proposed that the children with SLI were unable to use all the different elements necessary to create a complete and grammatical story due to their decreased language abilities and difficulty with processing. This pattern was seen in the current study, which suggests that the linguistic systems of children with SLI may be overtaxed when trying to produce complex sentence forms. As the children with SLI focused on producing sentences with a specific structure their ability to focus on other elements of grammar decreased.

As seen in the exploratory analysis in this study, the children with SLI were not using the relative marker "that" with clinician use of priming and recasting so the children may need to be explicitly taught to use the marker. While Huttenlocher,

Vasilyeva, and Shimpf found evidence that children with SLI were able to use more simple syntactic structures through implicit learning, the structures of more complex syntax may need to be explicitly taught. It is possible that a combination of an overtaxed linguistic system and the effect of priming could have impacted the children's creation of sentences without the relative marker "that." As the participant's produced sentences with "that," they may have been priming themselves to continue to not use "that." Research has shown that the more people use sentences with certain structures, the more likely they are to use that structure again (Bock, 1986). The more sentences the participants produced without using the marker "that," the more likely they were to continue not using the marker "that." By explicitly teaching the children to use "that," the clinician can make sure that the children are primed by the desired sentence structure.

In order to reduce the cognitive and linguistic load imposed by the complexity of the syntactic structure, clinicians may want to provide graphic organizers and/or visual cues. Explicit instruction through the use of visual/graphic organizers has been empirically validated for vocabulary and comprehension instruction and should support the development of syntactic knowledge as discourse demands increase (Kim, Vaughn, Wanzek, & Wei 2004). A graphic organizer to teach object relative clauses could include symbols that represent the different parts needed. The symbols could represent the object, the relative marker "that", the subject, and the verb phrase. For example, for the sentence, "The carrot that the rabbit ate was orange," the different parts would be: object ("The carrot"), relative marker ("that"), subject ("the rabbit ate"), and verb phrase ("was orange"). The clinician might want to include a symbol, like an arrow, to indicate that the verb phrase is referring to the object. Because of the pattern seen in the study of the children with SLI avoiding the use of the marker "that," it should be included as a

separate symbol/word on the graphic organizer. When using the organizer to teach the structure, the clinician should select pictures with a clear subject and object in order to make it easier for the child to see the relationship.

Another potential approach within which to embed priming and recasting is the use of vertical structuring. In vertical structuring, the child produces an utterance, then the clinician asks a question about the utterance so that the child must elaborate. The clinician then combines the child's utterance into one complex sentence (Schwartz, Chapman, Terrell, Prelock, & Rowan, 1985). For example, the child says, "The boy eats." The clinician asks, "What is the boy eating?" The child responds, "An apple." The clinician puts the two utterances together and says, "The boy eats an apple." This technique can be used with more complex sentences such as object relative clauses. The clinician first provides an example of the desired sentence structure (priming) and then presents the child with an opportunity to produce the sentence. For example, the clinician presents the child with a picture of a rabbit with a carrot. The child says, "The carrot is orange." The clinician asks, "Who is eating the carrot?" The child responds, "The rabbit." The clinician puts the utterances into an object relative clause by saying, "The carrot that the rabbit eats is orange." By combining the child's two utterances, the clinician is using the techniques of vertical structuring as well as recasting.

### **Limitations**

One limitation of the study was that there were only 26 participants. The participants also received only 40 opportunities for priming and production for each relative clause

type. A larger number of participants, and a longer stimulus set would provide more information particularly for the participants who were not primed within 40 opportunities provided. Additionally, all of the testing was conducted in one session. This may have impacted how well the participants could pay attention to the task. Additionally, no information about how long the effect of the priming lasted could be gathered because no follow up sessions were completed. Lastly, in further research, a language sample for each participant should be gathered before testing in order to analyze how often the participants are using subject relative and object relative clauses in their spontaneous speech.

### **Conclusions**

This study provides evidence that the use of priming combined with growth relevant recasts improved the use of specific syntactic structures for school-age children with and without SLI. In a relatively short amount of time, children can learn to use more complex syntactic structures through implicit instruction. In some cases, explicit instruction can be used in order to reduce the cognitive load on the child. Further research can examine the lasting effects the strategies of priming and recasting has on the production of complex sentences.

## REFERENCES

- Bock, J. K. (1986). Syntactic persistence in language production. *Cognitive Psychology*, 18(3), 355-387.
- Bracken, B.A., & McCallum, R.S. (1998). *Universal Nonverbal Intelligence Test*. Itasca, IL: Riverside Publishing.
- Frizelle, P., & Fletcher, P. (2014). Relative clause constructions in children with specific language impairment. *International Journal of Language and Communication Disorders*, 49(2), 255-264.
- Colozzo, P., Gillam, R.B., Wood, M., Schnell, R.D., & Johnston, J.R. (2011). Content and form in the narratives of children with specific language impairment. *Journal of Speech, Language, and Hearing Research*, 54, 1609-1627.
- Garraffa, M., Coco, M.I., & Branigan, H.P. (2012, March). Processing of subject relatives in SLI children during structural priming and sentence repetition. Poster session presented at the annual CUNY Conference on Human Sentence Processing, New York, NY.
- Halfbrick Studios. (2013). Fruit Ninja Free (Version 1.9.0) [Mobile application software]. Retrieved from [itunes.apple.com](https://itunes.apple.com)
- Hestvik, A., Schwartz, R. G., & Tornyova, L. (2010). Relative clause gap-filling in children with specific language impairment. *Journal of Psycholinguistic Research*, 39(5), 443-456.
- Huttenlocher, J., Vasilyeva, M., & Shimpi, P. (2004). Syntactic priming in young children. *Journal of Memory and Language*, 50(2), 182-195.

- Kim, A., Vaughn, S., Wanzek, J., & Wei, S. (2004). Graphic organizers and their effects on the reading comprehension of students with ld: a sysnthesis of research. *Journal of Learning Disabilities, 37*(2), 105-118.
- Miller, J. F., & Iglesias, A. (2008). Systematic Analysis of Language Transcripts (SALT), English & Spanish (Version 9) [Computer software]. Madison, WI: University of Wisconsin-Madison, Waisman Center, Language Analysis Laboratory.
- Nelson, K. E., Camarata, S. M., Welsh, J., Butkovsky, L., & Camarata, Mary (1996). Effects of imitative and conversational recasting treatment on the acquisition of grammar in children with specific language impairment and younger language-normal children. *Journal of Speech and Hearing Research, 39*(4), 850-859.
- Novogrodsky, R., & Friedmann, N. (2006). The production of relative clauses in syntactic SLI: A window to the nature of the impairment. *Advances in Speech Language Pathology, 8*(4), 364-375.
- Proctor-Williams, K., & Fey, M. (2007). Recast density and acquisition of novel irregular past tense verbs. *Journal of Speech, Language, and Hearing Research, 50*, 1029-1047.
- Proctor-Williams, K., Fey, M., & Loeb, D. (2001). Parental recasts and production of copulas and articles by children with specific language impairment and typical language. *American Journal of Speech-Language Pathology, 10*, 155-168.
- Schwartz, R.G., Chapman, K., Terrell, B.Y., Prelock, P., & Rowan, L. (1985). Facilitating word combination in language-impaired children through discourse structure. *Journal of Speech and Hearing Disorders, 50*, 31-39.

Semel, E., Wiig, E.H., & Secord, W.A. (2003). *Clinical evaluation of language*

*fundamentals – Fourth Edition*. San Antonio, TX: The Psychological Corporation.

## APPENDICES



## APPENDIX A. Demographic Variables

Table A.1. Demographic Variables

	<b>TD Group (n=13)</b>	<b>SLI Group (n=13)</b>	<b>P-Values</b>
<b>Age (in months)</b>	107.23 (17.39)	110 (12.46)	0.645
<b>CELF Raw Score</b>	59.46 (15.76)	34.08 (14.03)	0.001*
<b>CELF Standard Score</b>	10.15 (3.05)	4.15 (2.48)	0.001*
<b>UNIT Raw Score</b>	10.92 (4.15)	10.77 (4.02)	0.924
<b>UNIT Standard Score</b>	9.38 (2.5)	9.08 (3.01)	0.779

\*significant,  $p < .05$

Typically Developing (TD); Specific Language Impairment (SLI); Clinical Evaluation of Language Fundamentals (CELF); Universal Nonverbal Intelligence Test (UNIT)

## APPENDIX B. Sentence Stimuli for the Pictures

**Subject Relative**

- 1A. The girl that held the key above the table was happy.
- 1B. The man that held the fork in his hand was sad.
- 2A. The car that hit the tree next to the street was blue.
- 2B. The boy that hit the ball into the air was happy.
- 3A. The sock that was on the floor was striped.
- 3B. The shirt that was on the hanger was blue.
- 4A. The girl that opened the shed with her hand was sad.
- 4B. The man that opened the door with a key was happy.
- 5A. The sea lion that barked at the bird was tan.
- 5B. The dog that barked at the man was brown.
- 6A. The man that gave the money to the lady was tall.
- 6B. The boy that gave the bills to the girl was short.
- 7A. The man that threw the ball in the park was wearing a hat.
- 7B. The boy that threw the Frisbee in the backyard was wearing a jacket.
- 8A. The fox that chased the butterfly in the air was jumping.
- 8B. The horse that chased the dog in the field was running.
- 9A. The cake that had a flower on the top was on the table.
- 9B. The cookie that had chocolate chips in the dough was in the jar.
- 10A. The pig that sat in the mud was hungry.
- 10B. The man that sat in the chair was tired.

- 11A. The bird that flew over the barn was black.
- 11B. The dog that sat on the grass was brown.
- 12A. The boy that rode his bike to school had a green backpack.
- 12B. The girl that played on the swings had a purple jacket.
- 13A. The bear that ate the berries from the bush was still hungry.
- 13B. The cat that drank the milk from a bowl was still thirsty.
- 14A. The lady that saw the mouse on the table was screaming.
- 14B. The boy that held the bunny in his arms was laughing.
- 15A. The mom that read a book to the baby had a white shirt on.
- 15B. The lady that watched the man on the TV had a red dress on.
- 16A. The boy that wrote the letter with a pencil was sitting in a chair.
- 16B. The man that read the book in his hands was relaxed.
- 17A. The glove that lay behind the ball was brown.
- 17B. The shoes that sat next to the box were red.
- 18A. That girl that brushed her teeth with a toothbrush had a red robe on.
- 18B. The boy that combed his hair with a comb had a yellow sweater on.
- 19A. The dog that chased the bone over the hill wanted some food.
- 19B. The cat that climbed a tree in the forest wanted the bird.
- 20A. The girl that cleaned the bathtub in the house had a white shirt on.
- 20B. The boy that built the snowman in the snow wore a yellow hat.
- 21A. The girl that put the butterfly in the net wore a blue hat.
- 21B. The boy that put the bird in the cage had a red shirt on.
- 22A. The man that caught the fish from the river was tall.

- 22B. The woman that caught the raccoon in the trash was short.
- 23A. The girl that poured the milk onto the cereal had a purple headband.
- 23B. The woman that poured the juice into the glass wore a white shirt.
- 24A. The woman that performed a song for the show had a pink dress on.
- 24B. The dog that performed a trick for the boy sat on the floor.
- 25A. The boy that brought a toy to the school wore a yellow shirt.
- 25B. The dog that brought a stick to the man had black fur.
- 26A. The girl that toasted a marshmallow over the fire sat on a log.
- 26B. The woman that toasted sliced bread in the toaster had a black belt.
- 27A. The woman that unpacked the dishes from a box was tall.
- 27B. The man that unpacked the clothes from the suitcase had a tie on.
- 28A. The mom that cut the cake at the party had brown hair.
- 28B. The man that cut the pizza on the counter wore a red apron.
- 29A. The dog that scared the man on the pole barked loudly.
- 29B. The girl that scared the boy behind the tree had a yellow helmet on.
- 30A. The woman that pushed the stroller down the sidewalk walked slowly.
- 30B. The boy that pushed the chair across the room had no shoes on.
- 31A. The girl that pulled the sled up the hill wore a red coat.
- 31B. The dog that carried the ball through the grass was small.
- 32A. The man that cleaned the chairs in the car had a white shirt.
- 32B. The woman that buttoned the dress on the girl knelt on the floor.
- 33A. The boy's dad that tossed the ball in the pool was tall.
- 33B. The girl's dog that followed the cat across the hill was brown.

- 34A. The girl that stomped her foot on the toy was mad.
- 34B. The boy that grabbed the toy from the box was happy.
- 35A. The woman that walked the boy to the park had black pants.
- 35B. The boy that dropped the paper into the trash had a striped shirt.
- 36A. The man that gave the ball to the boy sat on the grass.
- 36B. The woman that stirred the soup on the stove wore a striped apron.
- 37A. The dog that drank the water in the bowl had a black nose.
- 37B. The cat that chased the mouse to the hole was orange.
- 38A. The woman's son that shared his food with the dog had red shoes.
- 38B. The girl's dad that pulled the sled on the snow had sunglasses on.
- 39A. The horse that pulled the wagon on the road was big.
- 39B. The boy that rode his bike on the path had a helmet on.
- 40A. The bear that watched the bee in the air held a basket.
- 40B. The mouse that ate the cheese on the plate was hungry.

### **Object Relative**

- 1A. The wheat that the farmer planted in the ground was small.
- 1B. The flower that the lady planted in the dirt was yellow.
- 2A. The axe that the lumberjack carried by the road was big.
- 2B. The baby that the mom carried in her arms was tired.
- 3A. The vegetable that the cook washed in the sink was red.
- 3B. The window that the girl washed with a rag was dirty.
- 4A. The mountain that the goat climbed during the day was tall.

- 4B. The tree that the monkey climbed by himself had green leaves.
- 5A. The door that the man closed with his hand was white.
- 5B. The box that the woman closed with her fingers was blue.
- 6A. The tooth that the nut cracked with its shell was white.
- 6B. The screen that the ball cracked with its side was blue.
- 7A. The baby that the dad fed on the couch was hungry.
- 7B. The kitten that the mom fed on the floor was black.
- 8A. The lady that the boy helped on the sidewalk was old.
- 8B. The children that the policeman helped across the street held a balloon.
- 9A. The cat that that boy kissed on the cheek was small.
- 9B. The puppy that the girl kissed on its ear was brown.
- 10A. The car that the woman parked on the road was red.
- 10B. The bike that the kid parked by the tree had black wheels.
- 11A. The apron that the lady ironed on a ironing board was pink.
- 11B. The ball that the kid bounced on the ground was brown.
- 12A. The tree that the car hit with its bumper was blue.
- 12B. The plant that the deer ate in the forest was green.
- 13A. The grass that the fire burned in the field was dead.
- 13B. The ball that the mule kicked with its legs was black and white.
- 14A. The girl that the boy pushed under the tree had a red shirt.
- 14B. The baseball that the man caught with a glove was white.
- 15A. The horse that the lady rode with a saddle was big.
- 15B. The car that the man drove during the night was black.

- 16A. The boy that the bully chased in the yard was scared.
- 16B. The dishes that the woman washed with a sponge were wet.
- 17A. The house that the man painted with a paintbrush was old.
- 17B. The cake that the cook baked in the oven was delicious.
- 18A. The book that the teacher read to the children was exciting.
- 18B. The song that the children sung in the snow was beautiful.
- 19A. The paper that the child cut with some scissors was green.
- 19B. The pencil that the girl sharpened on the table was long.
- 20A. The lollipop that the boy licked in the yard was big.
- 20B. The bone that the dog buried under a tree was white.
- 21A. The dog that the girl groomed with a brush was brown.
- 21B. The hair that the man groomed with a comb was short.
- 22A. The grass that the man cut with a lawnmower was tall.
- 22B. The paper that the girl cut with her scissors was white.
- 23A. The lady that the boy hugged in the snow was smiling.
- 23B. The cat that the girl hugged on the floor was spotted.
- 24A. The girl that the man pushed on the swing was happy.
- 24B. The sled that the girl pushed over the snow was brown.
- 25A. The soup that the man cooked on the stove was hot.
- 25B. The bread that the woman cooked in the microwave was burnt.
- 26A. The dog that the children washed in the tub was wet.
- 26B. The car that the man washed in the driveway was silver.
- 27A. The doll that the girl held in her arms was small.

- 27B. The boy that the man held on his shoulders was young.
- 28A. The apple that the boy grabbed from the tree was green.
- 28B. The toy that the girl grabbed from the sand was red.
- 29A. The wall that the woman painted in the house was green.
- 29B. The car that the man painted in a garage was blue.
- 30A. The berries that the girl ate at the table were red.
- 30B. The donut that the boy ate in the yard was pink.
- 31A. The mouse that the cat chased on the grass was brown.
- 31B. The rug that the man cleaned with a vacuum was white.
- 32A. The worm that the bird ate in the yard was slimy.
- 32B. The doll that the girl carried in her arms was small.
- 33A. The flower that the monster watered in the yard was pink.
- 33B. The nut that the squirrel ate on the ground was brown.
- 34A. The car that the woman drove on the road was red.
- 34B. The boat that the boy sailed on the water was purple.
- 35A. The egg that the woman cracked in the bowl was white.
- 35B. The cow that the man milked in the field was spotted.
- 36A. The berries that the boy picked from the bush were blue.
- 36B. The castle that the girl made on the beach was short.
- 37A. The nest that the bird made on the rock was brown.
- 37B. The fish that the bear caught in the river was slippery.
- 38A. The bike that the man rode on the street was blue.
- 38B. The barn that the farmer painted with a brush was grey.



39A. The bubble that the boy blew with his gum was big.

39B. The shirt that the woman sewed with a needle was green.

40A. The puppy that the boy held in his arms was brown.

40B. The carrot that the rabbit ate on the floor was orange.

## APPENDIX C. Stimuli Order Randomization for Participant Numbers

Participant 001 – 2 OR/SR

Participant 002 – 1 SR/OR

Participant 003 – 1 SR/OR

Participant 004 – 2 OR/SR

Participant 005 – 1 SR/OR

Participant 006 – 1 SR/OR

Participant 007 – 2 OR/SR

Participant 008 – 2 OR/SR

Participant 009 – 2 OR/SR

Participant 010 – 1 SR/OR

Participant 011 – 1 SR/OR

Participant 012 – 2 OR/SR

Participant 013 – 1 SR/OR

Participant 014 – 1 SR/OR

Participant 015 – 2 OR/SR

Participant 016 – 2 OR/SR

Participant 017 - 2 OR/SR

Participant 018 – 2 OR/SR

Participant 019 – 1 SR/OR

Participant 020 – 1 SR/OR

Participant 021 – 1 SR/OR

Participant 022 – 1 SR/OR

Participant 023 – 2 OR/SR

Participant 024 – 1 SR/OR

Participant 025 – 1 SR/OR

Participant 026 – 1 SR/OR

Participant 027 – 2 OR/SR

Participant 028 – 2 OR/SR

Participant 029 – 2 OR/SR

Participant 030 – 1 SR/OR

Participant 031 – 2 OR/SR

## APPENDIX D. Administration Procedure and Instructions

### **Picture stimuli**

Instructions: “I am going to show you a picture and tell you a sentence about the picture.

Then, I will show you another picture and I want you to tell me a sentence about it. Try to make your sentences sound like mine.”

### **3-minute break after 20 completed pairs**

Instructions: “You are working really hard. We are going to take a break.”

### **Picture stimuli**

Instructions: “Let’s look at our pictures again. I am going to show you a picture and say a sentence. Then I will show you a picture and you will make a sentence. Remember to try and make your sentences sound like mine.”

### **After 20 more completed pairs**

Administer the Symbolic Memory subtest of UNIT

Administer Sentence Repetition subtest of CELF

### **Picture stimuli**

Instructions: “We are going to look at some more pictures. I am going to show you a picture and tell you a sentence. Then I will show you another picture and you will make a sentence. These sentences will sound different than before. Try and make your sentences sound like mine.”

### **3-minute break after 20 completed pairs**

Instructions: “You are working really hard. We are going to take a break.”

### **Picture stimuli**

Instructions: “Let’s look at our pictures again. I am going to show you a picture and say a sentence. Then I will show you a picture and you will make a sentence. Remember to try and make your sentences sound like mine.”

APPENDIX E. Relationships Between Subject Relative & Object Relative Sentences, CELF-4 Scores & Subject Relative Trials to Criteria, And CELF-4 Scores & Object Relative Trials to Criteria.

Figure E.1. Mean trials to criteria on the subject relative sentences and the object relative sentences for the children in the typically developing (TD) group and the specific language impairment (SLI) group. Error bars represent 95% confidence intervals.

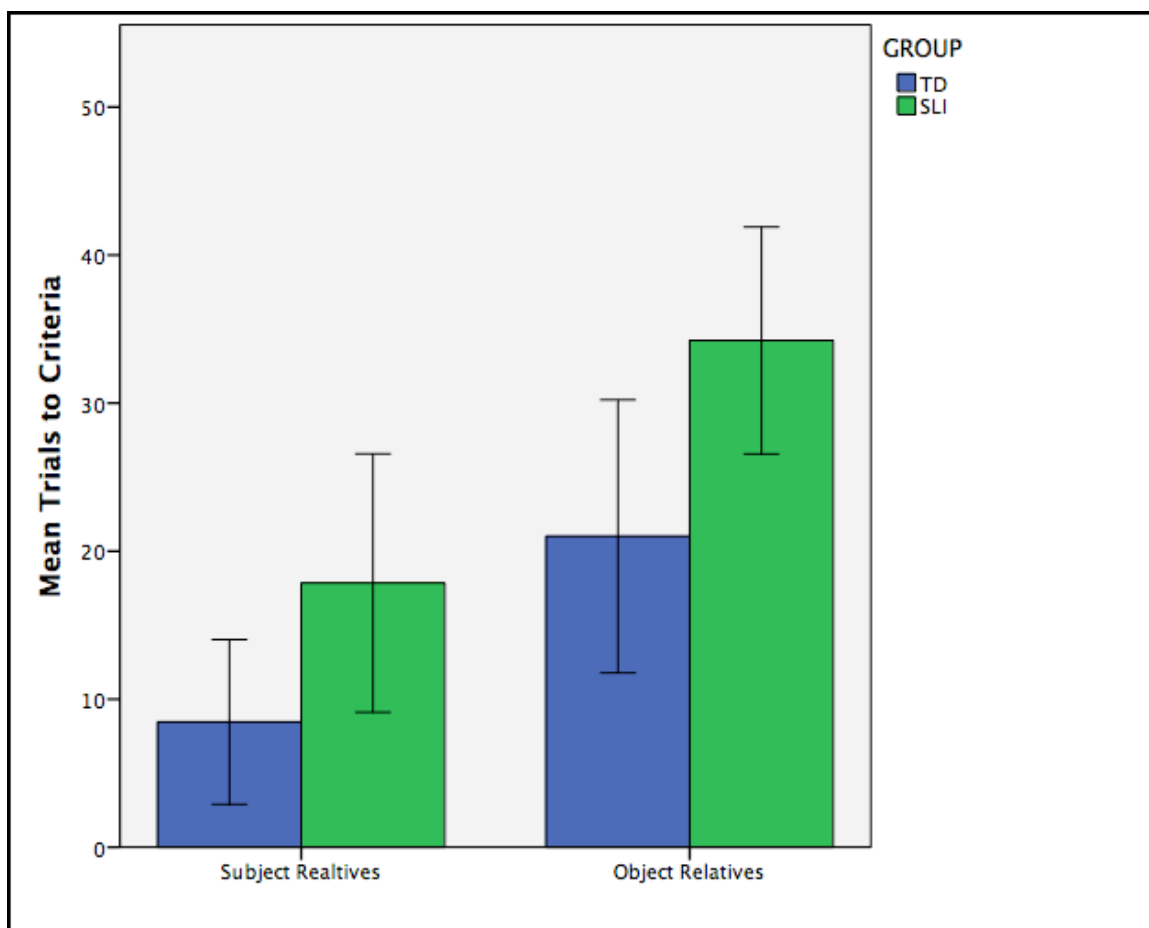


Figure E.2. Scatterplot of the relationship between CELF recalling sentences raw scores and subject relative trials to criteria (SRTTC) scores.

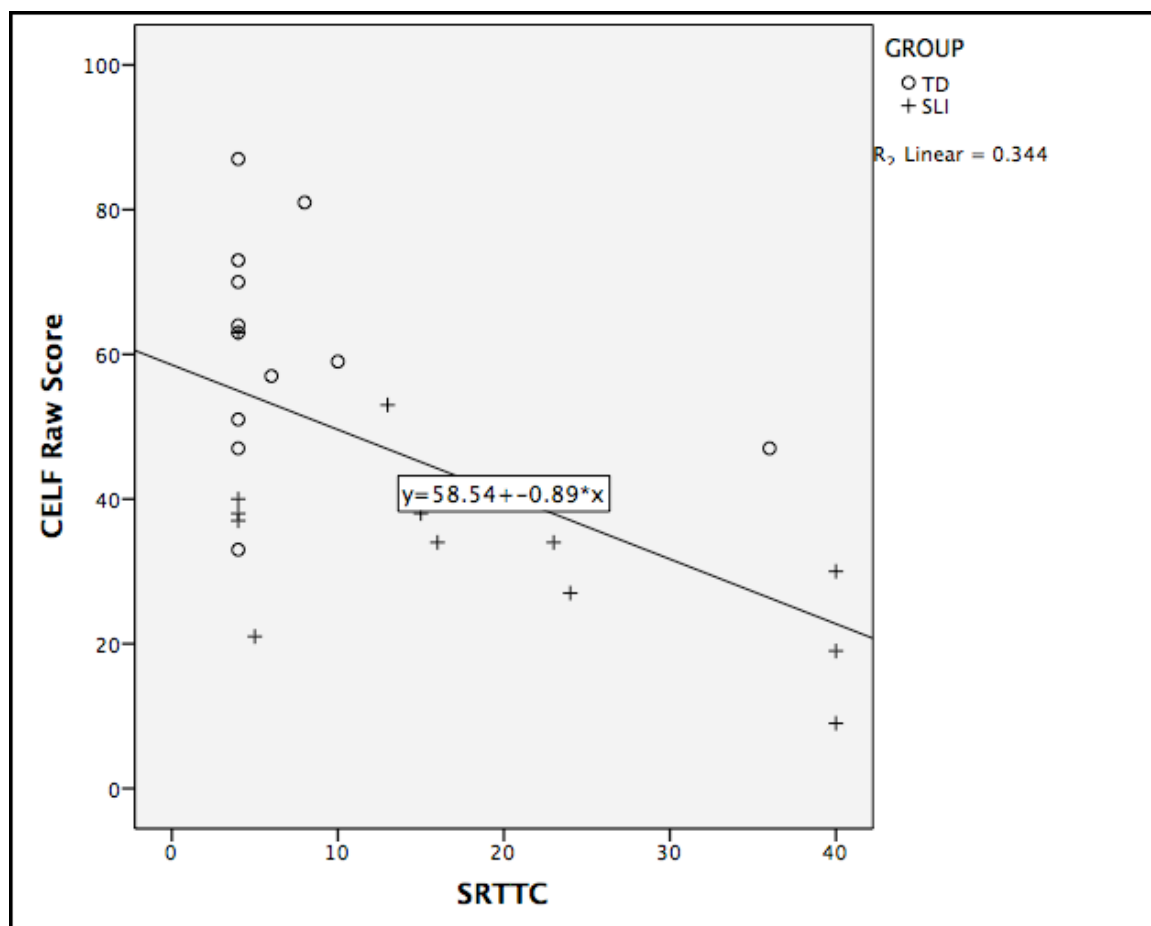
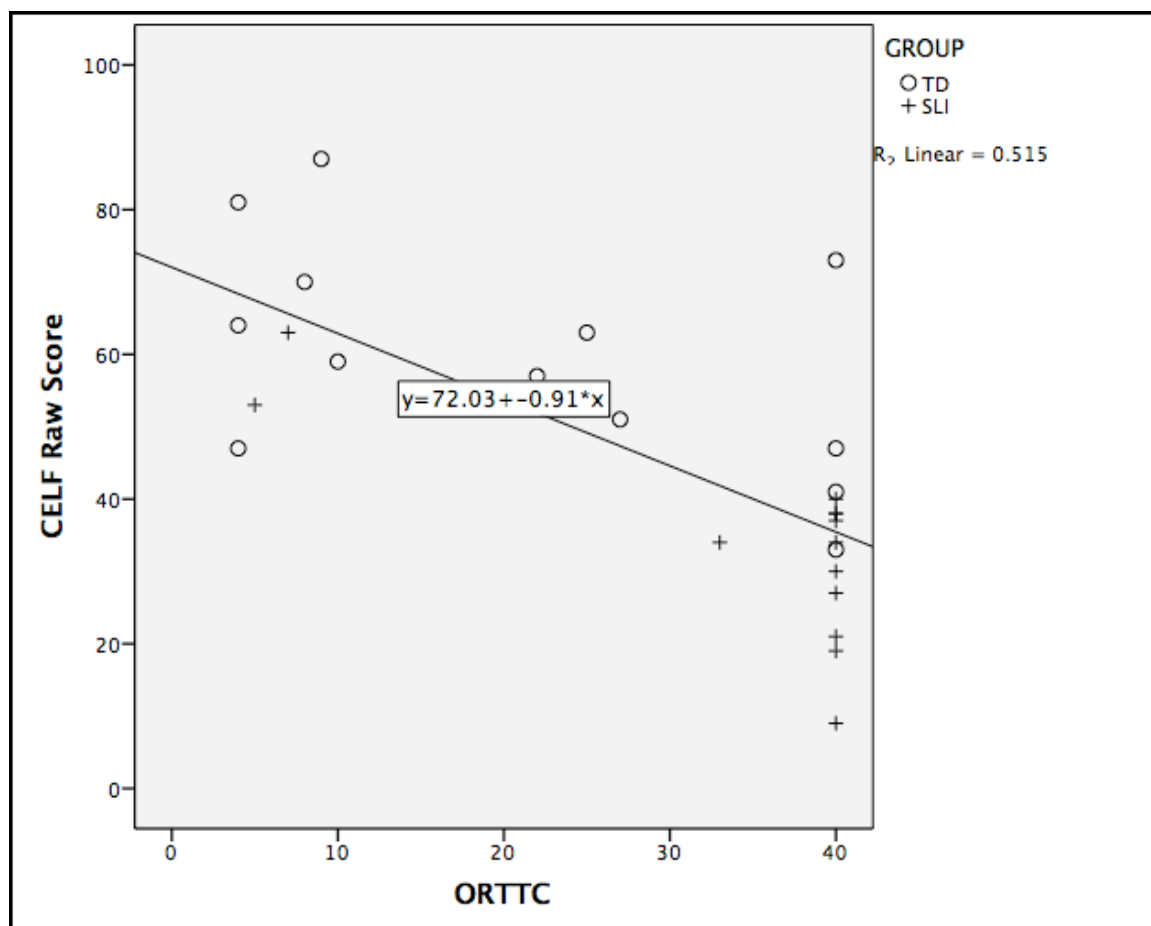


Figure E.3. Scatterplot of the relationship between CELF recalling sentences raw scores and object relative trials to criteria (ORTTC) scores.





## APPENDIX F. Response Type Definitions, Total Responses by Type, and Percentages of Responses

### Definitions & Examples for Types of Responses

**Total Responses** – The total number of responses made by the participant.

**Subject Relative** – A complete subject relative sentence when the desired sentence type is object relative.

**Object Relative** – A complete object relative sentence when the desired sentence type is subject relative.

**Relative Marker Change** – A complete subject relative or object relative sentence but the participant used “who” instead of “that.”

Ex: “The baker who made the cake wore a white hat.”

**Tense Change** – A complete subject relative or object relative sentence that contains present tense verbs or a mixture of present tense and past tense verbs.

Ex: “The lady who was watching TV is wearing a red coat.”

**Simple Ungrammatical** – An ungrammatical sentence.

Ex: “The cookies in the cookie jar didn’t have a lid on it.”

**Complex Ungrammatical** – An ungrammatical sentence that contains “that” or “who.”

Ex: “The mouse that was eating cheese and crackers like he’s going to eat the crackers separate from the cheese.”

**Preposition Reversal** – The location of the preposition is switched which results in semantic ambiguity.

Ex: “The cat that the girl brushed the comb with wasn’t happy.”

**Subject Relative/Object Relative** – The sentence is a mixture of two sentence types where the first part is subject relative and the second part is object relative.

Ex: “The lady who threw out a napkin was blue.” “The lady who threw out a napkin” is a subject relative form. “Was blue” is referring to the napkin and not the lady so it follows an object relative form.

**Object Relative/Subject Relative** – The sentence is a mixture of two sentence types where the first part is object relative and the second part is subject relative.

Ex: “The door that the man opened was joyful.” “The door that the man opened” is an object relative form. “Was joyful” is referring to the man and not the door so it follows a subject relative form.

**Deletion of “that”** - A complete, grammatical sentence in the desired sentence type that does not contain “that.” When occurring with a present tense verb, a deletion of “that” and the auxiliary verb occurs (e.g. “that is”).

Ex: “The woman making the food wore a white shirt.”

**Reduction** – A dependent clause is changed to an independent clause resulting in two simple sentences: one sentence that is incomplete and one that is complete.

Ex: “The man who brushed his hair. His shirt was blue.”

**Relative Clause Omission** – A complete, grammatical sentence that does not include a relative clause.

Ex: “The lady planted a plant in her garden.”

**2 Sentences** – Two complete, grammatical sentences are used to describe the picture.

Ex: “The boy was making a snowman. It’s white.”

**3 Sentences** – Three complete, grammatical sentences are used to describe the picture.

Ex: “The snowman’s name was Olaf. And he lived happily ever after. And he was a happy snowman.”

**Complement with “that”** – The sentence contains “that” being used to describe an object.

Ex: “The boy rode the bike that was red.”

**Coordinated with “and”** – A grammatical sentence that contained the conjunction “and.”

Ex: “The raccoon tipped over the garbage can and frightened the lady.”

**S V V2** – A sentence that contains one subject and two verbs.

Ex: “The lady who helped down the stairs was smiling.”

**Subordinate** – A grammatical sentence containing a subordinate clause using “when,” “but,” “so,” “while,” or “because.”

Ex: “The boy gave fake money to the girl when they were playing bank.”

Table F.1. Total Subject Relative Responses for TD Group

Participant	OR	RMC	TC	Simp UG	Comp UG	SR/ OR	OR/ SR	That (-)	Reduct	RCO	Coord	2 Sent	Sub
001	2	9	-	-	-	-	-	-	-	1	-	-	-
002	1	-	-	3	-	-	-	-	-	5	-	-	2
004	-	25	-	1	2	1	-	-	7	4	-	-	-
006	1	-	1	-	-	-	-	8	-	5	-	-	-
007	-	18	5	-	2	-	-	3	-	9	1	-	-
011	-	9	-	-	-	-	-	-	-	5	-	-	-
014	-	-	-	1	1	-	-	5	-	18	1	2	5
015	1	4	-	-	1	-	1	-	-	5	-	-	-
016	1	13	1	-	1	-	-	-	1	1	-	-	-
022	-	-	-	-	-	1	-	-	1	-	-	1	-
023	-	-	1	-	-	-	-	-	-	25	2	-	5
026	-	29	17	-	-	-	-	-	-	5	1	-	-
031	8	-	15	-	-	1	4	-	-	1	-	-	-
Total	14	107	40	5	7	3	5	16	9	84	5	3	12

Object Relative (OR); Relative Marker Change (RMC); Tense Change (TC); Simple Ungrammatical (Simp UG); Complex Ungrammatical (Comp UG); Subject Relative/Object Relative (SR/OR); Object Relative/Subject Relative (OR/SR); Deletion of “that” (That [-]); Reduction (Reduct); Relative Clause Omission (RCO); Coordinated (Coord); 2 Sentences (2 Sent); Subordinated (Sub)

Table F.2. Total Subject Relative Responses for TD Group

Participant	OR	RMC	TC	Simp UG	Comp UG	SR/ OR	OR/ SR	That (-)	Reduct	RCO	Coord	2 Sent	3 Sent	S V V2	Sub
003	2	30	-	1	-	-	-	-	-	1	-	-	-	-	-
005	-	2	-	4	-	-	-	-	-	3	-	-	-	-	-
009	-	-	-	2	-	-	-	-	1	28	1	8	-	-	-
012	-	26	2	-	-	11	-	-	-	3	-	-	-	-	-
017	3	4	-	-	1	-	-	-	-	24	-	-	-	-	1
018	-	-	-	2	1	-	-	-	4	14	1	4	-	-	4
019	-	-	-	4	-	-	-	1	-	29	2	3	-	-	-
020	-	-	-	3	-	-	-	11	1	17	1	7	-	-	-
025	-	9	-	-	-	-	-	-	-	19	-	2	-	-	2
027	-	-	-	-	2	-	-	-	1	3	-	1	-	-	1
028	1	5	1	1	1	-	2	-	-	11	-	-	1	-	-
029	-	30	2	-	-	1	-	-	3	1	-	-	-	1	1
030	-	-	3	2	1	-	-	1	6	1	-	5	-	-	1
Total	6	106	8	19	6	12	2	13	16	154	5	30	1	1	10

Object Relative (OR); Relative Marker Change (RMC); Tense Change (TC); Simple Ungrammatical (Simp UG); Complex Ungrammatical (Comp UG); Subject Relative/Object Relative (SR/OR); Object Relative/Subject Relative (OR/SR); Deletion of "that" (That [-]); Reduction (Reduct); Relative Clause Omission (RCO); Coordinated (Coord); 2 Sentences (2 Sent); 3 Sentences (3 Sent); Subject Verb Verb2 (S V V2); Subordinated (Sub)

Table F.3. Total Subject Relative Responses for TD Group

Participant	SR	TC	Simp UG	Comp UG	SR/ OR	OR/ SR	That (-)	Reduct	RCO	Comp	Coord	2 Sent	Sub
001	3	2	-	-	-	-	-	-	2	-	-	-	-
002	27	-	-	-	-	-	-	-	4	-	1	-	-
004	-	-	1	-	9	-	-	3	13	1	-	-	2
006	-	2	-	-	-	-	-	-	1	-	-	-	-
007	7	-	1	1	2	-	-	1	18	-	-	-	-
011	10	-	-	-	-	-	4	-	-	-	-	-	-
014	14	-	-	2	6	4	-	-	10	-	-	-	-
015	2	2	-	2	1	-	-	-	-	-	-	2	1
016	9	2	-	2	7	-	-	7	-	1	-	-	-
022	15	-	-	-	2	-	-	-	1	-	-	-	-
023	5	-	-	-	3	-	-	1	26	-	-	-	-
026	11	7	-	1	7	-	4	-	2	-	1	-	1
031	2	15	-	2	3	1	3	-	7	4	-	-	1
Total	105	30	2	10	40	5	11	12	84	6	2	2	5

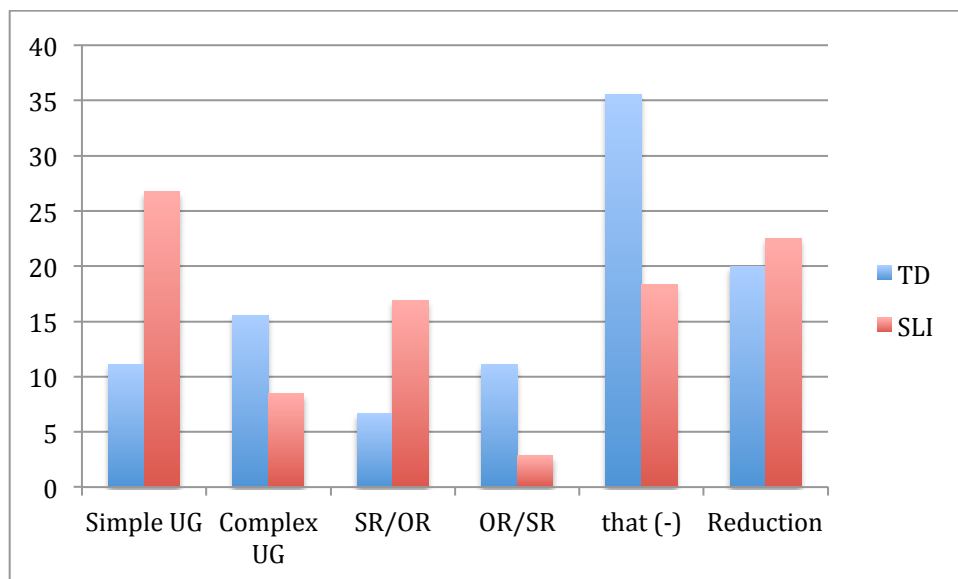
Subject Relative (SR); Tense Change (TC); Simple Ungrammatical (Simp UG); Complex Ungrammatical (Comp UG); Subject Relative/Object Relative (SR/OR); Object Relative/Subject Relative (OR/SR); Deletion of “that” (That [-]); Reduction (Reduct); Relative Clause Omission (RCO); Complement (Comp); Coordinated (Coord); 2 Sentences (2 Sent); Subordinated (Sub)

Table F.4. Total Subject Relative Responses for TD Group

Participant	SR	RMC	TC	Simp UG	Comp UG	SR/ OR	OR/ SR	Reduct	RCO	Comp	Coord	2 Sent	3 Sent	Sub
3	18	-	-	1	-	5	-	-	1	1	-	-	-	-
5	3	-	1	-	-	-	1	-	2	-	-	-	-	-
9	-	-	-	4	-	-	-	-	25	1	-	4	3	-
12	15	-	-	-	-	24	-	-	1	-	-	-	-	-
17	1	-	-	-	-	-	-	2	19	-	-	-	-	-
18	2	-	-	-	4	3	-	7	5	-	1	11	1	6
19	-	-	-	4	-	-	-	-	35	-	1	-	-	-
20	-	-	-	11	-	-	-	-	25	-	1	3	-	-
25	14	-	-	-	1	15	-	1	6	2	-	-	-	-
27	27	-	-	-	2	6	-	1	1	1	-	1	-	1
28	20	-	-	-	7	2	4	-	4	-	-	-	-	-
29	8	1	-	1	-	7	-	3	7	-	1	9	1	2
30	20	-	-	-	3	9	-	5	-	-	1	-	-	-
Total	128	1	1	21	17	71	5	19	131	5	5	28	5	9

Subject Relative (SR); Relative Marker Change (RMC); Tense Change (TC); Simple Ungrammatical (Simp UG); Complex Ungrammatical (Comp UG); Subject Relative/Object Relative (SR/OR); Object Relative/Subject Relative (OR/SR); Reduction (Reduct); Relative Clause Omission (RCO); Complement (Comp); Coordinated (Coord); 2 Sentences (2 Sent); 3 Sentences (3 Sent); Subordinated (Sub)

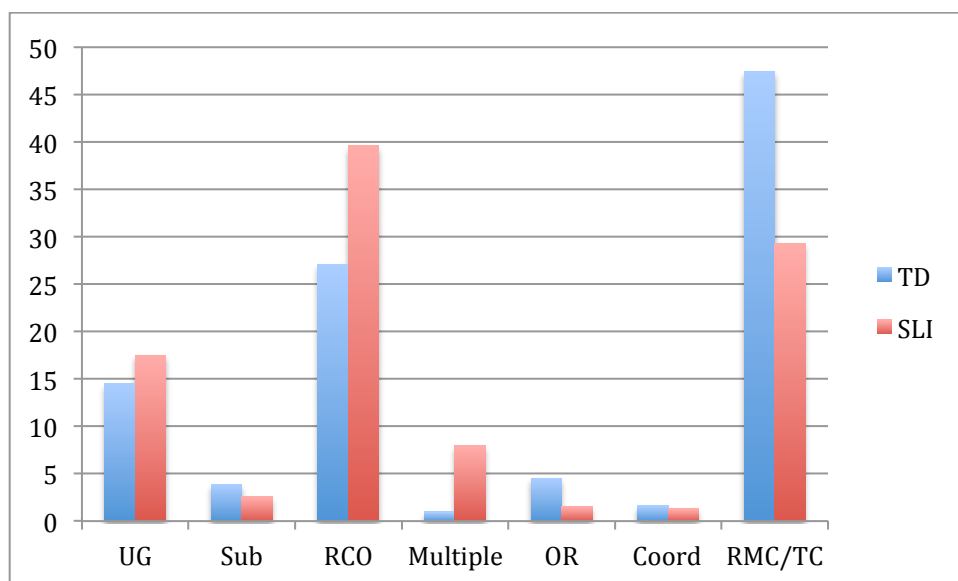
Figure F.5. Percentage of Responses for Subject Relative Ungrammatical Error Group



Ungrammatical (UG); Subject Relative (SR); Object Relative (OR); Deletion of “That”  
(That [-])

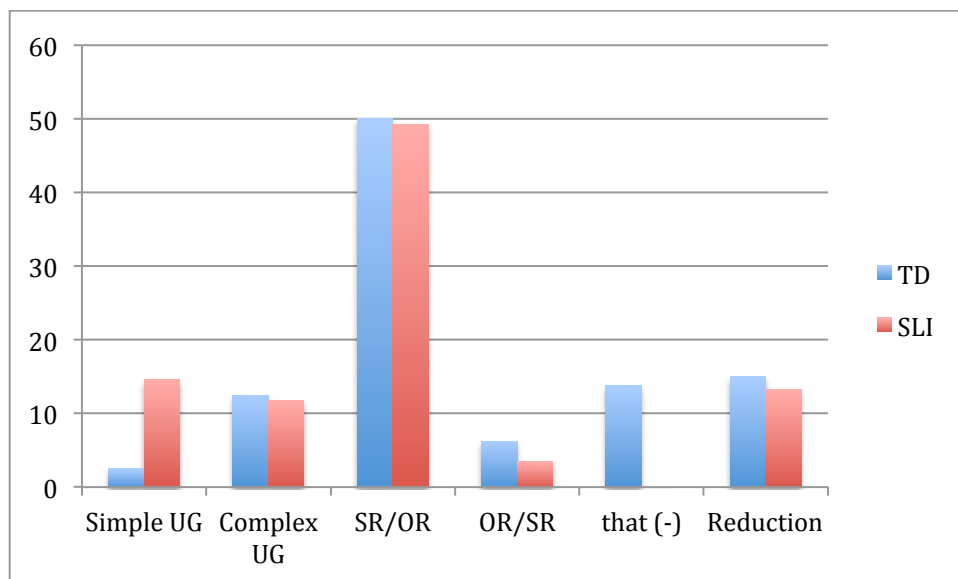


Figure F.6. Percentages of Responses in Each Group for Subject Relative



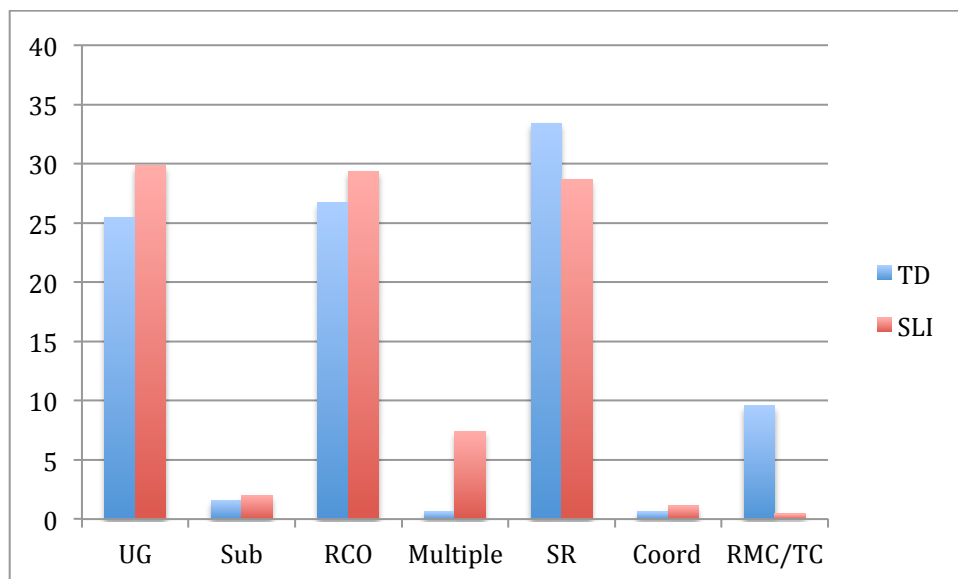
Ungrammatical (UG); Subordinate (Sub); Relative Clause Omission (RCO); Multiple Sentences (Multiple); Object Relative (OR); Coordinated (Coord); Relative Marker Change (RMC); Tense Change (TC)

Figure F.7. Percentage of Responses for Object Relative Ungrammatical Error Group



Ungrammatical (UG); Subject Relative (SR); Object Relative (OR); Deletion of “That”  
(That [-])

Figure F.8. Percentage of Responses in Each Group for Object Relative



Ungrammatical (UG); Subordinated (Sub); Relative Clause Omission (RCO); Multiple Sentences (Multiple); Subject Relative (SR); Coordinated (Coord); Relative Marker Change (RMC); Tense Change (TC)